PIEZOELECTRIC TRANSFORMER AND ITS MANUFACTURE

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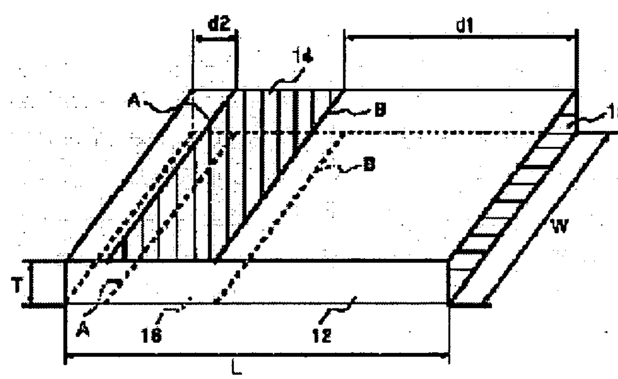
Abstract of **JP9116205**

PROBLEM TO BE SOLVED: To change the specification of a Rosen type piezoelectric transformer regarding the input-side capacitance and boosting ratio or reduce the fluctuation of the capacitance and ratio by only adjusting the shapes of primary-side electrodes by using the same size of ceramic plates. SOLUTION: The capacitance and boosting ratio of a piezoelectric transformer are changed by adjusting the positions of the front ends B and base-side ends A of the primary-side electrodes 14 and 16 of the transformer, namely, the distance di between secondary-side electrodes and the interval d2 between the primary-side electrodes and the base-side end of a ceramic plate of the transformer. When, for example, the boosting ratio is raised, the distance d1 is increased and, when the ratio is lowered, the interval d2 is increased. When the capacitance is reduced, the distance d1 or interval d2 is increased. When the capacitance is reduced without changing the boosting ratio, in addition, both the distance di and interval d2 are increased at a fixed ratio.



CLAIMS

[Claim(s)]
[Claim 1] The manufacture approach of the piezoelectric transformer characterized by including the process in which the size of a primary lateral electrode is adjusted in the manufacture approach of the Rosen mold piezoelectric transformer in order to change upstream electrostatic capacity or a pressure-up ratio.
[Claim 2] The manufacture approach of the piezoelectric transformer characterized by adjusting either [at least] the 1st distance between the tip of a primary lateral electrode, and a secondary electrode, or the end face of a primary lateral electrode, the end face of a ceramic plate and the 2nd distance of a between in the manufacture approach according to claim 1 in said process to adjust.
[Claim 3] The manufacture approach of the piezoelectric transformer characterized by adjusting said 2nd distance to a larger value than 0 in the manufacture approach according to claim 2 in said process to adjust.
[Claim 4] The manufacture approach of the piezoelectric transformer characterized by adjusting the both sides of said 1st distance and 2nd distance in the manufacture approach according to claim 2 in said process to adjust.
[Claim 5] The manufacture approach of the piezoelectric transformer characterized by increasing or decreasing said the 1st distance and 2nd distance at the rate of a constant ratio in order to change upstream electrostatic capacity in the manufacture approach according to claim 4 in said process to adjust, maintaining a pressure-up ratio uniformly.
[Claim 6] The manufacture approach of the piezoelectric transformer characterized by adjusting either [at least] said 1st distance or the 2nd distance in the manufacture approach according to claim 2 in said process to adjust by within the limits whose effectiveness of a piezoelectric transformer is 90% or more.
[Claim 7] The manufacture approach of a piezoelectric transformer ~~that either [at least]~~ the tip of said primary lateral electrode or a end face is characterized by removing only the required amount of adjustments in the manufacture approach according to claim 1 in said process to adjust.
[Claim 8] In the approach of manufacturing two or more sorts of Rosen mold piezoelectric transformers with a different specification about upstream electrostatic capacity or a pressure-up ratio The process which prepares two or more electrostrictive ceramics plates formed in the same size with the same ingredient, In order that the process which is equipped with the process which forms the primary lateral electrode adjusted to size which is different for every specification to the prepared electrostrictive ceramics plate, and forms said primary lateral electrode may attain the upstream electrostatic capacity and the pressure-up ratio specified by each specification The manufacture approach of the piezoelectric transformer characterized by including the process in which either [at least] the 1st distance between the tip of said primary lateral electrode and a secondary electrode or the 2nd distance between said primary lateral electrode end faces and end faces of said electrostrictive ceramics plate is adjusted for every specification.
[Claim 9] In the approach of manufacturing two or more Rosen mold piezoelectric transformers which have a single specification about upstream electrostatic capacity or a pressure-up ratio The process

which prepares two or more electrostrictive ceramics plates formed in the same size with the same ingredient, Or it has the process which forms the primary lateral electrode adjusted to different size for every group of an electrostrictive ceramics plate. the prepared electrostrictive ceramics plate -- every electrostrictive ceramics plate -- In order that the process which forms said primary lateral electrode may attain the upstream electrostatic capacity and the pressure-up ratio specified by said specification Either [at least] the 1st distance between the tip of said primary lateral electrode, and a secondary electrode, or the 2nd distance between said primary lateral electrode end faces and end faces of said electrostrictive ceramics plate every electrostrictive ceramics plate -- or the manufacture approach of the piezoelectric transformer characterized by including the process adjusted for every group of an electrostrictive ceramics plate.

[Claim 10] The process in which a piezoelectric transformer with the primary lateral electrode of predetermined size is manufactured in the manufacture approach according to claim 9 using some electrostrictive ceramics plates of the prepared inside, The process in which it asks for deflection with the upstream electrostatic capacity and the pressure-up ratio which measure the upstream electrostatic capacity and the pressure-up ratio of a piezoelectric transformer with the primary lateral electrode of said predetermined size, and this measured value and said specification specify, The manufacture approach of the piezoelectric transformer characterized by having further the process in which either [at least] said 1st distance over some [another] electrostrictive ceramics plates of the prepared inside or said 2nd distance is adjusted, based on said deflection.

[Claim 11] The process in which a piezoelectric transformer with the primary lateral electrode of predetermined size is manufactured in the manufacture approach according to claim 9 using the prepared electrostrictive ceramics plate, The process in which it asks for deflection with the upstream electrostatic capacity and the pressure-up ratio which measure upstream electrostatic capacity and a pressure-up ratio, and this measured value and said specification specify about each of a piezoelectric transformer with the primary lateral electrode of said predetermined size, The manufacture approach of the piezoelectric transformer characterized by having further the process in which either [at least] said 1st distance or said 2nd distance is adjusted based on said deflection, in each of said piezoelectric transformer.

[Claim 12] The Rosen mold piezoelectric transformer with which it has an electrostrictive ceramics plate, a primary lateral electrode, and a secondary electrode, and the distance between the end face of said primary lateral electrode and the end face of said electrostrictive ceramics plate is adjusted to the larger value than 0.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is concerned with a piezoelectric transformer and its manufacture approach.
[0002]
[Description of the Prior Art] A piezoelectric transformer attaches the upstream and a secondary electrode in the electrostrictive ceramics plate which uses PZT (titanic-acid lead zirconate), BT (barium titanate), etc. as a principal component, and carries out polarization processing of the ceramics in the predetermined direction. For example, the most common piezoelectric transformer called the "Rosen mold" In a long and slender thin electrostrictive ceramics plate, it has the primary lateral electrode (a primary lateral electrode on the back serves also as a secondary electrode) of two sheets the end face side which met in the die-length direction to front flesh-side both sides of about 50% of part. It has the secondary electrode of one sheet in the end face by the side of the tip which met in the die-length direction, and polarization processing of the ceramic part between primary lateral electrodes is carried out in the thickness direction, and polarization processing of the secondary inter-electrode ceramic part is carried out in the die-length direction.
[0003] According to the conventional technique, when changing the pressure-up ratio and electrostatic capacity of a piezoelectric transformer, configurations, such as the die length and width of face of a ceramic plate, and thickness, are changed. Therefore, metal mold for the piezoelectric transformer with which specifications differ to manufacture it, since the configurations of the ceramic plate itself differ is another, and the case of another configuration is prepared also about the case where a piezoelectric transformer is put in.
[0004] Moreover, it has been tried for the electrostrictive ceramics plate which uses PZT, BT, etc. as a principal component to control a process more strictly for this cure, since electrostatic capacity changes with dispersion in manufacture processes, such as preparation and baking. However, in the present condition, dispersion in 20% of electrostatic capacity is seen at the maximum. Therefore, when dispersion in input-side electrostatic capacity needs to be made small by constraint of a drive circuit etc., the approach of sorting out by inspection after manufacture etc. must be taken.
[0005] In the pressure-up ratio, a maximum of about 20% of dispersion occurred similarly, and when it is many, the input voltage by the side of a control circuit and adjustment of drive frequency have amended this.
[0006]
[Problem(s) to be Solved by the Invention] According to the conventional technique, the piezoelectric transformer with which specifications differ must be manufactured using different metal mold etc., and cases also differ. Moreover, since inspection etc. needs to sort out in order to make dispersion in electrostatic capacity small, while taking big time and effort, a lot of defectives are generated. Moreover, in order to adjust a pressure-up ratio in a control circuit, it is necessary to carry out the load of the components to a control circuit. From such a situation, there are problems, like that cost becomes high

and a control circuit becomes large-sized.
[0007] On the other hand, the technique of improving the property of a piezoelectric transformer is indicated by publication of unexamined utility model application Showa 50-35173, publication of unexamined utility model application Showa 55-149970, and publication of unexamined utility model application Showa 53-89177 by changing the die length of the primary lateral electrode of the Rosen mold piezoelectric transformer. However, the technique of adjusting a primary lateral electrode as a solution over modification and dispersion of the input-side electrostatic capacity mentioned above and a pressure-up ratio is not indicated by these reference.
[0008] Therefore, in the Rosen mold piezoelectric transformer, the purpose of this invention is to offer the technique which input-side electrostatic capacity and a pressure-up ratio are changed, or can make dispersion small, when the configuration of an electrostrictive ceramics plate is not changed but ** also adjusts the size of a primary lateral electrode.
[0009]
[Means for Solving the Problem] The manufacture approach of the Rosen mold piezoelectric transformer of following this invention includes the process in which the size of a primary lateral electrode is adjusted, in order to change the upstream electrostatic capacity or the pressure-up ratio of a transformer. Like this adjustment fault, it can carry out in a design stage or an inspection phase in a production process etc.
[0010] Like this adjustment fault, it carries out by [as adjusting at least one side of the end face of a primary lateral electrode, the end face of a ceramic plate, and 1st distance / between the tip of a primary lateral electrode, and a secondary electrode /, and distance / of ** the 2nd of a between / **] desirably. In the usual case, the both sides of the 1st distance and the 2nd distance are adjusted. In many cases, the 2nd distance is adjusted to a larger value than 0.
[0011] Thus, by adjustment of the 1st distance about a primary lateral electrode, and the 2nd distance, the approach of this invention of adjusting upstream electrostatic capacity and a pressure-up ratio is based on the new knowledge which invention-in-this-application persons acquired experimentally so that it may explain in full detail behind.
[0012] If based on this knowledge, a pressure-up ratio can be lowered by being able to raise a pressure-up ratio and increasing the 2nd distance by increasing the 1st distance, for example. Moreover, by increasing one side or the both sides of the 1st distance and the 2nd distance, upstream electrostatic capacity can be made small and electrostatic capacity can be made small by increasing the 1st distance and 2nd distance with [both] a specific ratio especially, without changing a pressure-up ratio.
[0013] Although adjustment of the 1st distance and the 2nd distance can be performed over a quite extensive range, it is desirably carried out within restricted limits [as / whose effectiveness of a piezoelectric transformer is 90% or more]. This restricted range is range near [distance / 1st] 1/2 of the overall length of a piezoelectric transformer, and is range near [distance / 2nd] 0.
[0014] The manufacture approach of this invention can be used for the purpose which manufactures two or more sorts of piezoelectric transformers with a different specification about upstream electrostatic capacity or a pressure-up ratio using a common electrostrictive ceramics plate. In that case, the primary lateral electrode of size adjusted to the electrostrictive ceramics plate of common size for every specification as mentioned above is formed. Even if specifications differ, the ceramic plate of common size can be used, and since product size is also the same, cost falls.
[0015] The manufacture approach of this invention can be used also for the purpose which controls dispersion about many the electrostatic capacity and the pressure-up ratios of a piezoelectric transformer which are manufactured under a single specification again. In that case, according to a difference of the property for every electrostrictive ceramics plate, or a difference of every group's (for example, each manufacture lot) property of an electrostrictive ceramics plate, a primary lateral electrode is adjusted as mentioned above, respectively. After the one way calcinates many electrostrictive ceramics plates of common size, it manufactures the forerunner article which used some ceramic plates of them and had the primary electrode of predetermined size, measures the electrostatic capacity and the pressure-up ratio of the forerunner article, and adjusts the primary electrode size of a consecutiveness article as mentioned

above based on the deflection of the measured value and desired value on a specification. Moreover, after forming the primary electrode of predetermined size uniformly for all products, another way performs grinding or etching to a primary electrode so that electrostatic capacity and a pressure-up ratio may be measured and the deflection from a specification may be corrected according to an individual for every product. The piezoelectric transformer of the small high quality of dispersion can be someday manufactured also in a way.
[0016] The 2nd distance of the above is adjusted to the larger value than 0 as a description on the configuration, that is, it is separated from many of piezoelectric transformers manufactured according to this invention of between the end face of a primary lateral electrode, and the end faces of a ceramic plate.
[0017]
[Embodiment of the Invention] Manufacture of a piezoelectric transformer will be performed at the process generally shown in drawing 1 , if the case of press forming is taken for an example. First, after mixing a binder and corning fine particles adjusted, reacted and ground, such as PZT or BT, by predetermined combination, press forming is carried out to a predetermined configuration after taking contraction by baking into consideration according to the 1 axial-stress force of about [1-2t //cm] two. Next, after removing by heating the binder added at the granulation process till around 600-degree Centigrade (cleaning), it doubles with the class of ingredient and calcinates at the temperature of 1000-degree more than Centigrade to which the consistency becomes sufficiently large. Furthermore, after preparing a configuration by grinding, an electrode is formed by silver baking, silver nickel plating, etc. Finally, it inspects by performing polarization processing by impressing the high voltage. In addition, the approach of extrusion molding, doctor blade shaping, CIP shaping, etc. is also performed besides press forming. Moreover, about an electrode, base metal, such as noble metals other than silver and copper, is also used.
[0018] Now, in addition to the general production process shown in drawing 1 , the manufacture approach of following this invention includes further the process in which the size of a primary electrode is adjusted. By including this process, it can be made correctly in agreement with the value of a request of the input electrostatic capacity or the pressure-up ratio of a piezoelectric transformer now so that it may mention later. ** in which the following thing is possible as a result
[0019] ** Manufacture the piezoelectric transformer of two or more specifications with different input electrostatic capacity or a different pressure-up ratio using the electrostrictive ceramics plate of the same size.
** Minimize the input electrostatic capacity of the piezoelectric transformer manufactured under the specific specification, or dispersion of a pressure-up ratio, and manufacture a quality piezoelectric transformer.
[0020] The process in which primary electrode size is adjusted can be carried out by either of the three following modes.
[0021] ** In the phase of a design, adjust electrode size so that desired electrostatic capacity and a desired pressure-up ratio can be obtained.
** After baking, carry out electrode formation by using some products as a forerunner article at the beginning as a design, and adjust the electrode size which should be formed in a consecutiveness product based on the inspection result of the forerunner article.
** Manufacture all products at the beginning as a design, and adjust an electrode by approaches, such as grinding or etching, for each product of every in the phase of the final inspection according to an inspection result.
[0022] Here, the mode of ** can be adopted when designing the piezoelectric transformer of two or more specifications using the electrostrictive ceramics plate of the same size. That is, the optimal primary electrode size is determined by the design stage for every specification. In this case, in order to suppress dispersion in a final product, it is desirable to also use the mode of ** or ** together. Moreover, the mode of ** and ** is employable in order to minimize dispersion in a final product under a specific specification. Among these, the mode of ** is excellent in the field of a throughput, and the

mode of ** is excellent in the field of high quality.
[0023] Next, the concrete approach of adjusting primary lateral electrode size is explained. The common Rosen mold piezoelectric transformer has the secondary electrode 8 of one sheet in the end face by the side of the tip which has the primary lateral electrodes 4 and 6 of two sheets at the front face and rear face of about 50% of part the end face side which met in the die-length direction of the long and slender thin electrostrictive ceramics plate 2 (the primary lateral electrode 16 on the back serves also as a secondary electrode), and met in the die-length direction, as shown in drawing 2 . On the other hand, typically, as shown in drawing 3 , the piezoelectric transformer with which primary lateral electrode size was adjusted according to this invention is adjusted so that the location of the end face A of the primary lateral electrodes 14 and 16 and the location at Tip B may obtain desired electrostatic capacity and a desired pressure-up ratio. As shown in drawing 3 , in the following explanation In addition, the distance of the tip B of the primary lateral electrodes 14 and 16, and the secondary electrode 18 Distance (henceforth end face spacing) of the end face A of d1 and the primary lateral electrodes 14 and 16 and the end face of the ceramic plate 12 is set to d2 for (it is hereafter called the distance between 2 lateral electrodes), and L and width of face are set to W, and thickness is set to T for the die length of a ceramic plate.
[0024] Now, in the common Rosen mold piezoelectric transformer shown in drawing 2 , the die length of the primary lateral electrodes 4 and 6 is 50% of die-length L of the ceramic plate 2. Under the conditions of these 50%, it is known that the pressure-up ratio of a piezoelectric transformer is proportional to the die length (that is, distance of the primary lateral electrodes 4 and 6 and the secondary electrode 8) d1 of a transformer, and it is in inverse proportion to thickness (that is, primary lateral electrode 4, distance between six) T of a transformer. Then, as a result of an invention-in-this-application person's experimenting about a piezoelectric transformer as shown in drawing 3 , even when the die length of the primary lateral electrodes 14 and 16 did not fulfill 50% of the overall length L, the knowledge that the same relation as the 50 above-mentioned% of case was mostly realized in a certain amount of range was acquired. Furthermore, when the primary lateral electrodes 14 and 16 were shortened from the end face A side, the knowledge that the fall of a pressure-up ratio was seen was also acquired (when it was got blocked and the end face spacing d2 was increased). If based on these two new knowledge, it will become possible to adjust upstream electrostatic capacity and a pressure-up ratio by adjusting the die length of the primary lateral electrodes 14 and 16 as follows in the piezoelectric transformer shown in drawing 3 .
[0025] ** When raising a pressure-up ratio, shorten the primary lateral electrodes 14 and 16 from Tip B side, and increase the secondary inter-electrode distance d1.
** When lowering a pressure-up ratio, shorten the primary lateral electrodes 14 and 16 from a end face A side, and increase the end face spacing d2.
** When making upstream electrostatic capacity small, make small short ******** and primary lateral electrode area from end face A or Tip B side for the primary lateral electrodes 14 and 16.
** When making electrostatic capacity small, without changing a pressure-up ratio, make small short ******** and primary lateral electrode area for the primary lateral electrodes 14 and 16 from the both sides by the side of a end face A and Tip B.
[0026] It will be as follows if an example is shown. The result of having measured upstream electrostatic capacity, a pressure-up ratio, and effectiveness (power conversion effectiveness) is shown in drawing 4 , drawing 5 , and drawing 6 about the Rosen mold piezoelectric transformer of L= 28.0mm of the gestalt shown in drawing 3 , W= 7.5mm, and T= 2.0mm size, changing d1 and d2. Moreover, the relation between upstream electrostatic capacity and a pressure-up ratio is shown in drawing 7 . Here, a pressure-up ratio is a pressure-up ratio when making it the output voltage of 225V join the pressure-up ratio 22 between the I/O electrical potential differences when adjusting input voltage so that the load resistance 22 of 75kohm may be connected to the secondary electrode of a piezoelectric transformer 20 and the 3mA load current may flow to this, i.e., the load resistance of 75kohm, as shown in drawing 8 .
[0027] According to the result shown in drawing 4 , it turns out that upstream electrostatic capacity becomes small, so that the secondary inter-electrode distance d1 and the end face spacing d2 increase

(i.e., so that the area of the primary lateral electrodes 14 and 16 becomes small). It is because inter-electrode electrostatic capacity is proportional to an electrode surface product as everyone knows. Therefore, a pressure-up ratio should just adjust at least one side of the secondary inter-electrode distance d1 and the end face spacing d2 to ignore and adjust electrostatic capacity.
[0028] About a pressure-up ratio, if a pressure-up ratio increases to the distance of a certain extent and end face spacing d2 is enlarged, a pressure-up ratio will become small, as the secondary inter-electrode distance d1 is developed so that drawing 5 may show. Therefore, what is necessary is just to increase in number or decrease the both sides of d1 and d2, in adjusting electrostatic capacity, without changing a pressure-up ratio. For example, in drawing 4 and drawing 5 , by 600pF, although a pressure-up ratio is 5 times, electrostatic capacity a common Rosen mold piezoelectric transformer (d1=14mm and d2=0mm) What is necessary is to shorten the primary lateral electrodes 14 and 16 (d1=15mm), and just to carry out them 1mm, from a end face A, from 2mm short hiding (d2=2mm) and Tip B, in reducing only electrostatic capacity from 600pF to 450pF, with [the 5 times as many as this] pressure-up ratio **** maintenance carried out. Furthermore, if it becomes (d1=16mm), a pressure-up ratio can adjust [which shortened 4mm (d2=4mm) and was shortened 2mm from Tip B from the end face A] electrostatic capacity to 320pF, maintaining about 5 times.
[0029] Moreover, if based on the relation between electrostatic capacity as shown in drawing 7 , and a pressure-up ratio, a piezoelectric transformer with the pressure-up ratio and electrostatic capacity of arbitration can be designed by adjusting d1 and d2. for example, a pressure-up ratio -- if it is 5 times and a transformer with an electrostatic capacity of 320pF -- d -- 1= 16mm d 2= 4mm and a pressure-up ratio -- if it is 600pF in 4 times and electrostatic capacity -- d -- 1= 12mm d 2= 2mm -- as -- it comes out. However, about effectiveness, in order to fall remarkably by shifting d1 extremely from L/2, or enlarging d2 extremely, in the application which needs [a certain / extent] output power, it is desirable to adjust within the limits of 90% or more of effectiveness in consideration of problems, such as generation of heat inside Torrance.
[0030] When performing electrode adjustment by the design stage, it can carry out as explained above. On the other hand, when adjusting a consecutiveness article based on the inspection result of a forerunner article, it can carry out as follows.
[0031] the transformer (L= 28.0mm, W= 7.5mm, and T= 2.0mm) explained above -- as a standard specification -- the electrostatic capacity of 500pF, and a pressure-up ratio -- 4.4 times -- setting up -- a forerunner article -- d -- suppose that it manufactured under 1= 14mm d 2= 2mm design. In this case, as drawing 5 shows, in design point d1=14mm and d2=2mm, the inclination to d1 of a pressure-up ratio is -0.3-/mm. Therefore, if the value which inclined the difference (G-4.4) of G then G, and the target pressure-up ratio 4.4, and did the division of the pressure-up ratio measured about the forerunner article by 0.3 is subtracted from the design value of 14mm of d1, a pressure-up ratio can be adjusted to desired value.
[0032] Moreover, as drawing 4 shows, in design point d1=14mm and d2=2mm, the inclination to the primary electrode die length (L-d1-d2) of electrostatic capacity is 40pF/mm. Therefore, if the value which inclined the difference (C-500) with C then a C, and a target electrostatic capacity of 500pF, and did the division of the electrostatic capacity measured about the forerunner article by 80 is applied to the design value of primary electrode die length (L-d1-d2), electrostatic capacity can be adjusted to desired value. In this case, primary electrode die length already needs to deduct from the amount of adjustments (C-500) / 40 of the primary electrode die length by which only - (G-4.4)/0.3 asked for this adjusted part upwards since only - (G-4.4)/0.3 were adjustments since d1 was an adjustment that is, for adjustment of a pressure-up ratio. Therefore, the final amount of adjustments of primary electrode die length is set to (C-500) / 40+ (G-4.4) / 0.3.
[0033] Furthermore, when the amount of adjustments of d1 and the amount of adjustments of d2 are set to 1:2 so that drawing 5 may show, since only electrostatic capacity can be adjusted without changing a pressure-up ratio, the amount of adjustments (C-500) / 40+ (G-4.4) / 0.3 of the above-mentioned final primary electrode die length are distributed to d1 and d2 at a rate of 1:2.
[0034] If the above approach is packed, d1 and d2 after adjustment will be expressed by the degree type,

and they should just determine d1 and d2 of late-coming elegance according to this formula.
d1=14-(G-4.4)/0.3+(C-500) (/40+ (G-4.4)/0.3)/3d2=2+ (C-500) (/40+ (G-4.4)/0.3), 2/3 [0035] The result of having examined the adjustment effectiveness by the above-mentioned approach about five product lots is shown in drawing 9 . The size and the specification of the transformer used by this trial are as the value used by the upper explanation. And for every lot containing 100 piece, ten forerunner articles were chosen, it manufactured at the beginning as the design (d1=14mm, d2=2mm), 50 late-coming elegance was adjusted according to the above-mentioned formula based on the electrostatic capacity C of these forerunner article, and the measured value of the pressure-up ratio G, and the 50 remaining pieces were manufactured at the beginning as the design, without adjusting. In addition, in the trial, since screen-stencil of 0.5mm unit performed electrode formation, adjustment of d1 and d2 was carried out with the value of 0.5mm unit nearest to the calculated value by the above-mentioned formula. The both sides of calculated value and the carried-out value are shown in drawing 9 as reference.
[0036] When it evaluated with the whole 5 lot so that drawing 9 may show, about the pressure-up ratio, distribution narrowed in the 4.1 times [4.8 times to] as many range as this by the sample which adjusted to the sample which is not adjusted having been distributed over the 3.7 times [5.1 times to] as many range as this. That is, dispersion in a pressure-up ratio narrowed in **** 1/2. Moreover, about electrostatic capacity, distribution narrowed in the range of 530pF - 470pF in what was adjusted to having been distributed over the range whose sample which is not adjusted is 570pF - 410pF. That is, dispersion in electrostatic capacity narrowed in about 1/3. Moreover, lot-to-lot dispersion is mostly lost by adjustment so that the average of each lot may show.
[0037] How to adjust each product to the last according to the result of final product inspection is explained. This approach is adjusted according to a formula which described above d1 and d2 of each product concerned based on the inspection results C and G about each product. In this case, the once formed electrode cannot be lengthened, but since it can only perform being shortened by grinding, etching, etc., in the design stage, dispersion in a product should be expected and only that part should set up the primary lateral electrode size (that is, d1 and d2 short). For example, although the design of a forerunner article was set to d1=14mm and d2=2mm by the approach of adjusting a consecutiveness article from the forerunner article explained above, if it is the same specification, an electrode will be designed a little more greatly like d1=12mm and d2=0mm by this approach.
[0038] Drawing 10 shows the result of having performed the evaluation trial, about how to adjust to this each. The size and the specification of the transformer used by this trial were as the value illustrated by the upper explanation, after manufacturing by the design of d1=12mm and d2=0mm, calculated d1 and d2 in the above-mentioned formula, and performed grinding according to calculated value. Adjusting 50 pieces by this approach about the lot which has entered 100 piece, remaining 50 pieces formed the electrode by the design of d1=14mm and d2=2mm about the sample which was not adjusted and which is not adjusted. About the sample which adjusted, get down to **2% of within the limits as **, and dispersion of a pressure-up ratio and electrostatic capacity was almost lost, and it is said for things that they are made so that drawing 10 may show.
[0039] As mentioned above, although the suitable operation gestalt of this invention was explained, this invention can be carried out in various modes other than the above. the piezoelectric transformer of the specific size for which invention-in-this-application persons used the formula shown above by the trial, the specific quality of the material, and a specific specification -- setting -- being effective -- it is necessary to pass and to use the formula according to it to the piezoelectric transformer of ** and other gestalten However, the principle of this invention is widely applicable to various sizes, the quality of the material, and the Rosen mold piezoelectric transformer of a specification.
[0040]
[Effect of the Invention] According to this invention, in the Rosen mold piezoelectric transformer, it is possible by adjusting the configuration of a primary lateral electrode using the ceramic plate of the same size to change input-side electrostatic capacity and the specification about a pressure-up ratio, or to make the dispersion small.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The flow chart which shows the production process of a common piezoelectric transformer.

[Drawing 2] The perspective view showing the common Rosen mold piezoelectric transformer.
[Drawing 3] The perspective view showing the Rosen mold piezoelectric transformer with which the primary lateral electrode was adjusted according to this invention.
[Drawing 4] Drawing showing the experimental result which investigated the relation between the amount of adjustments of a primary lateral electrode, and upstream electrostatic capacity.
[Drawing 5] Drawing showing the experimental result which investigated the relation between the amount of adjustments of a primary lateral electrode, and a pressure-up ratio.
[Drawing 6] Drawing showing the experimental result which investigated the relation between the amount of adjustments of a primary lateral electrode, and effectiveness.
[Drawing 7] Drawing showing the experimental result which investigated the relation between a pressure-up ratio and upstream electrostatic capacity.
[Drawing 8] The block diagram showing the measuring circuit used for the experiment.
[Drawing 9] The graph showing the evaluation test result about the approach of adjusting a late-coming article based on the inspection result of a forerunner article.
[Drawing 10] The graph showing the result of the evaluation trial about the approach of adjusting each product based on an inspection result.
[Description of Notations]
12 Electrostrictive Ceramics Plate
14 Primary Lateral Electrode
16 Primary Lateral Electrode (it Serves Also as Secondary Electrode)
18 Secondary Electrode
A The end face of a primary lateral electrode
B The tip of a secondary electrode
d1 End face spacing
d2 Secondary inter-electrode distance
L The die length of a piezoelectric transformer (piezo-electric ceramic plate)
W Width of face of a piezoelectric transformer (piezo-electric ceramic plate)
T Thickness of a piezoelectric transformer (piezo-electric ceramic plate)

[Translation done.]

* NOTICES *

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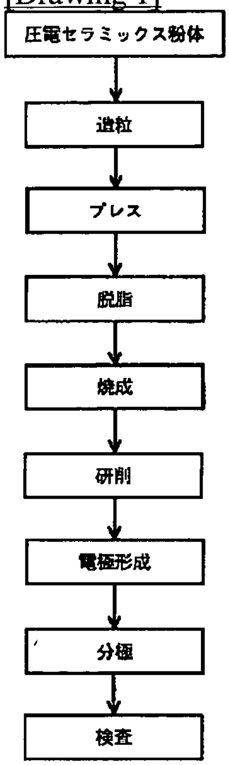
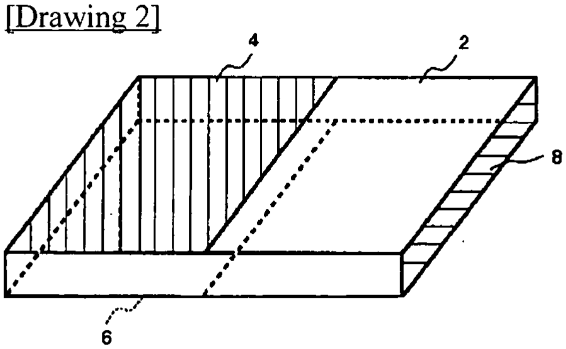
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

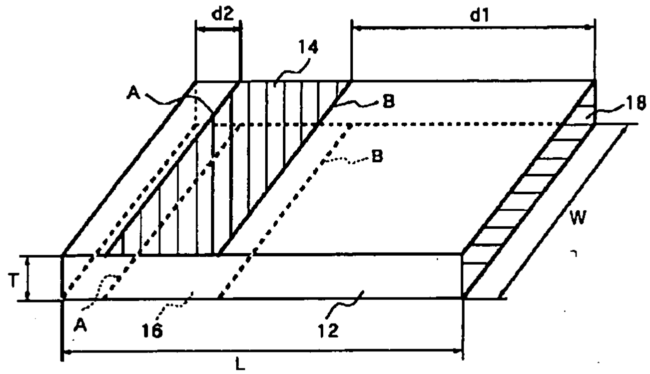
[Drawing 1]



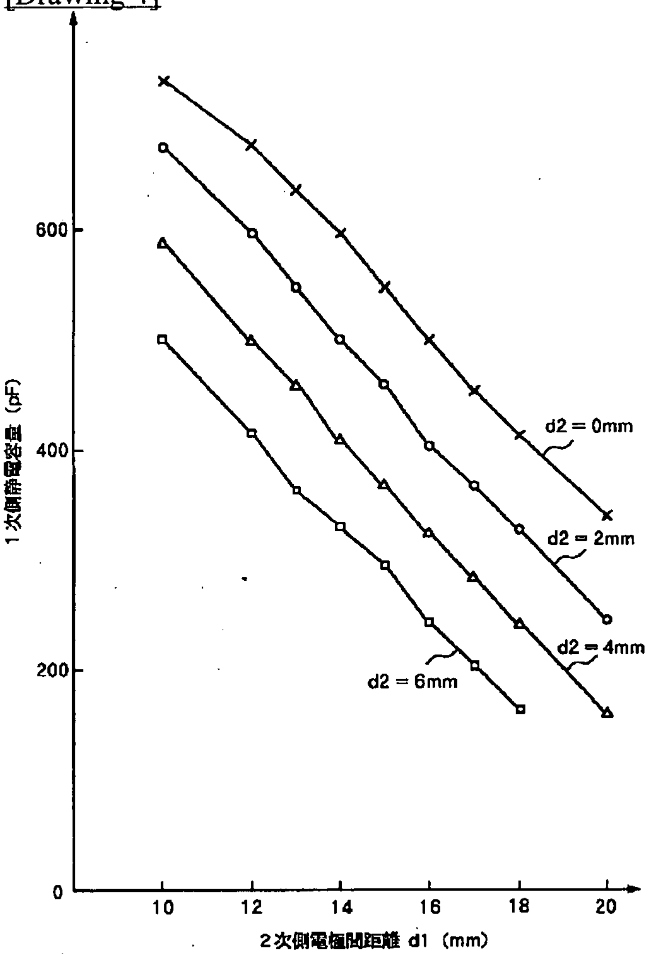
[Drawing 2]



[Drawing 3]



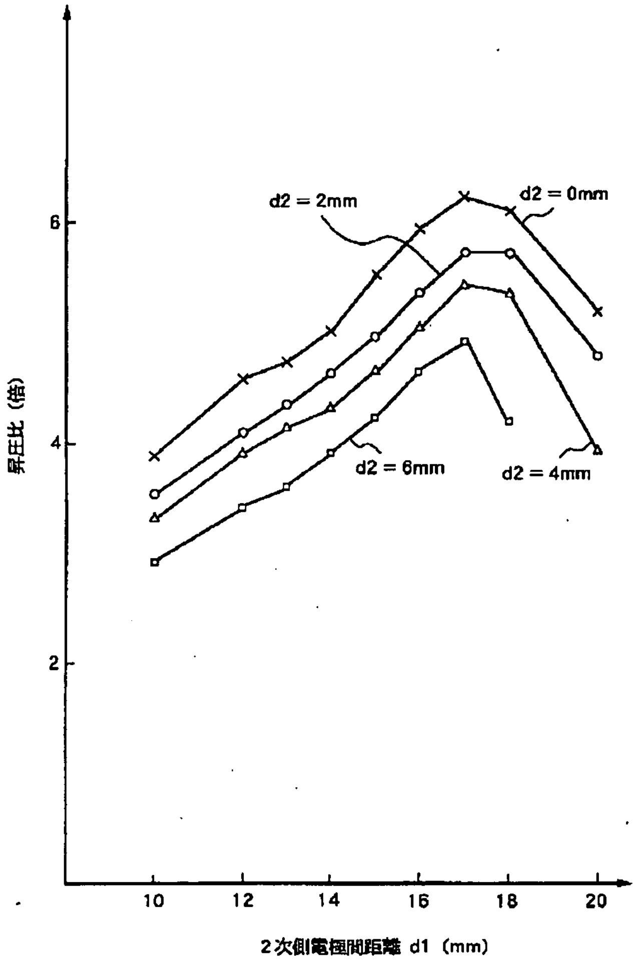
[Drawing 4]



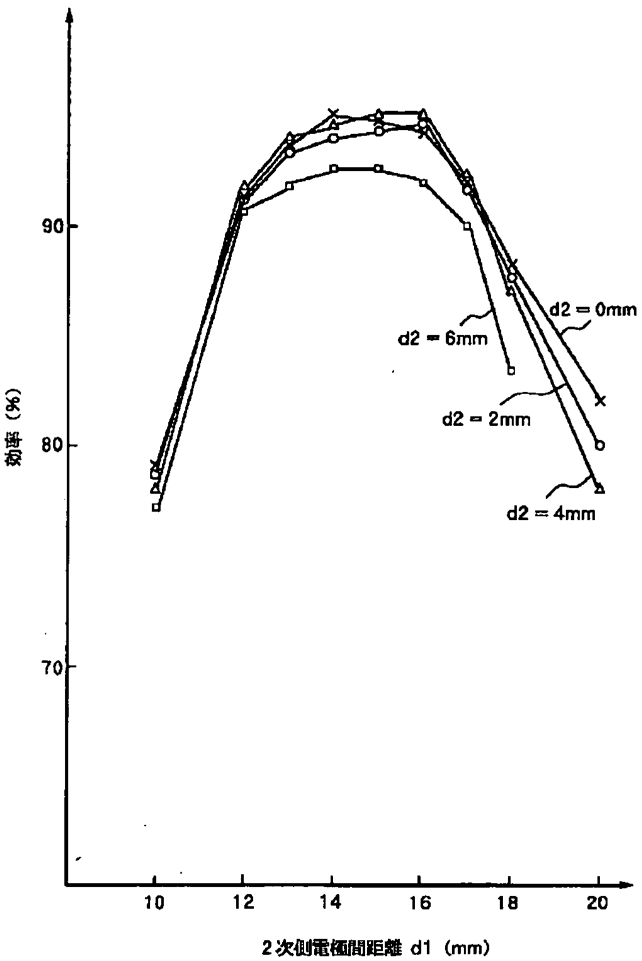
[Drawing 10]

		調整有り	調整なし
補正しない場合			
昇圧比	平均値	4.4	4.0
	最大値	4.5	4.2
	最小値	4.4	3.7
静電容量	平均値	500	460
	最大値	510	480
	最小値	490	430

[Drawing 5]


d2 = 2mm
d2 = 0mm
d2 = 6mm
d2 = 4mm
昇圧比（倍）
6
4
2
10
12
14
16
18
20
2次側電極間距離 d1（mm）

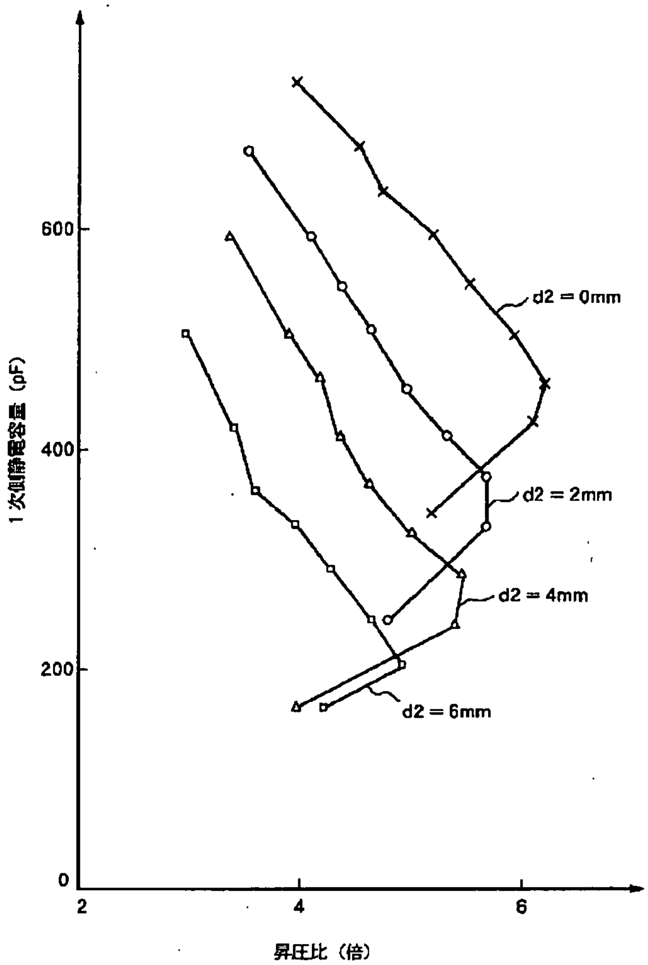
[Drawing 6]



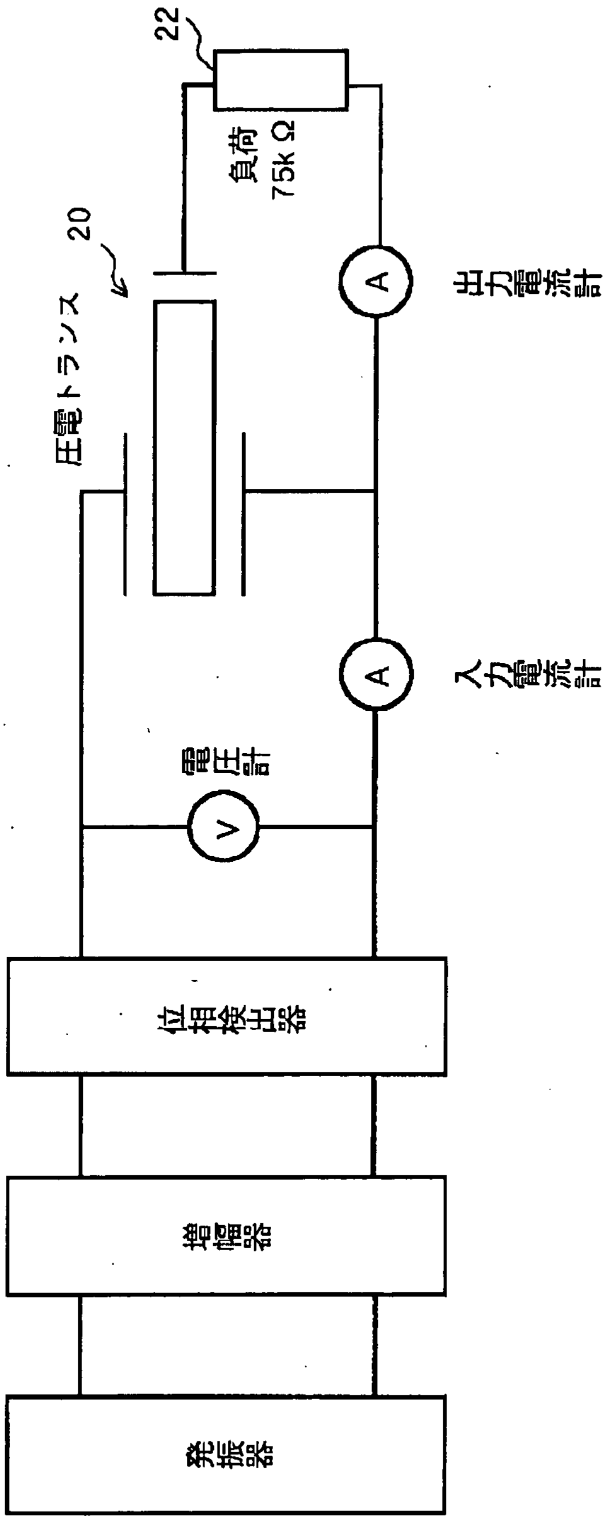
[Drawing 9]

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
先発品昇圧比 (G)	4.3	4.0	4.5	4.7	4.9
先発品静電容量 (C)	530	490	500	450	540
計算値 d1	14.472	14.806	13.778	12.917	13.222
d2	2.227	0.944	2.222	1.833	3.778
実施した値 d1	14.35	14.95	13.8	13.05	13.2
d2	2.15	1.05	2.2	1.95	3.8
調整しない場合					
昇圧比 平均値	4.4	4.0	4.6	4.7	4.9
最大値	4.7	4.2	4.8	4.9	5.1
最小値	4.2	3.7	4.4	4.4	4.6
静電容量 平均値	540	490	510	440	530
最大値	570	520	530	480	560
最小値	520	460	490	410	510
調整した場合					
昇圧比 平均値	4.5	4.5	4.4	4.4	4.3
最大値	4.8	4.8	4.7	4.6	4.6
最小値	4.1	4.2	4.2	4.2	4.1
静電容量 平均値	480	490	510	500	500
最大値	500	530	530	520	530
最小値	470	470	490	470	480

[Drawing 7]



[Drawing 8]



[Translation done.]